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Prevalence of cardiovascular disease risk factor in the Chinese population: the 2007–2008 China National Diabetes and Metabolic Disorders Study

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Aims

Cardiovascular disease (CVD) is now the most prevalent and debilitating disease affecting the Chinese population. The goal of the present manuscript was to analyse cardiovascular risk factors and the prevalence of non-fatal CVDs from data gathered from the 2007–2008 China National Diabetes and Metabolic Disorders Study.

Methods and results

A nationally representative sample of 46 239 adults, 20 years of age or older, was randomly recruited using a multi-stage stratified design method. Lifestyle factors, diagnosis of CVD, stroke, diabetes, and family history of each subject were collected, and an oral glucose tolerance test or a standard meal test was performed. Various non-fatal CVDs were reported by the subjects. SUDAAN software was used to perform all weighted statistical analyses, with $P < 0.05$ considered statistically significant. The prevalence of coronary heart disease, stroke, and CVDs was 0.74, 1.07, and 1.78% in males; and 0.51, 0.60, and 1.10% in females, respectively. The presence of CVDs increased with age in both males and females. The prevalence of being overweight or obese, hypertension, dyslipidaemia, or hyperglycaemia was 36.67, 30.09, 67.43, and 26.69% in males; and 29.77, 24.79, 63.98, and 23.62% in females, respectively. In the total sample of 46 239 patients, the prevalence of one subject having 1, 2, 3, or ≥4 of the 5 defined risk factors (i.e. smoking, overweight or obese, hypertension, dyslipidaemia, or hyperglycaemia) was 31.17, 27.38, 17.76, and 10.19%, respectively. Following adjustment for gender and age, the odds ratio of CVDs for those who had 1, 2, 3, or ≥4 risk factors was 2.36, 4.24, 4.88, and 7.22, respectively, when compared with patients with no risk factors.

Conclusion

Morbidity attributed to the five defined cardiovascular risk factors was high in the Chinese population, with multiple risk factors present in the same individual. Therefore, reasonable prevention strategies should be designed to attenuate the rapid rise in cardiovascular morbidity.

Keywords Cardiovascular disease • Stroke • Risk factor • Morbidity

Introduction

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in the world;[1] incidentally, it remains the most important disease affecting the health of the Chinese population. The proportion of deaths in China caused by CVD compared with all other causes of death has increased from 12.8% in 1951 to 35.8% in 1990.[2] The early detection and treatment of high-risk patients has been enforced as a key strategy in the prevention of CVD.[1] Ageing, cigarette smoking, physical inactivity, overweight and obesity, hypertension, dyslipidaemia, and hyperglycaemia are traditional risk factors in the development of CVD. The likelihood of being diagnosed with or developing CVD is significantly increased if one or more of these risk factors are present.[3–6] With rapid changes in urbanization, industrialization, and lifestyle, the morbidities related to being overweight, obese, hypertensive,

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dyslipidaemic, or diabetic all present an accelerated trend in the Chinese population. This increase in the presence of CVD is likely to further accelerate, ultimately increasing the medical burden of Chinese patients. Recent data suggests that the prevalence of diabetes in adults aged 20 or older has risen to an alarming 9.7% in China.[7] Therefore, it is necessary to understand the other risk factors involved in this progression as well as to establish reasonable prevention strategies to attenuate this rapid rise in morbidity related to CVD. However, no large-scale national representative epidemiological data are available to analyse the prevalence of these cardiovascular risk factors within the last 10 years in China. The 2007–08 China National Diabetes and Metabolic Disorders Study includes these data and remains the latest nationwide cross-sectional survey. Based on this survey database, we analysed the prevalence of cardiovascular risk factors and non-fatal CVDs in the Chinese population, compared the family background and traditional risk factors of coronary heart disease (CHD) and stroke, and provided evidence for high-risk populations to further control CVDs.

Methods

Study population

The data used in the present study are from the 2007–08 China National Diabetes and Metabolic Disorders Study, a cross-sectional study which obtained data from June 2007 to May 2008. This survey used a multistage stratified sampling design. A total of 152 cities and 112 counties that were representative of other neighbouring cities were selected throughout the country based on geographical distribution, economic development, and urbanization. The subjects, ≥20 years of age who had been residents for more than 5 years, were randomly selected from each region. The details used for the sampling methods were based on a previous study by our group.[7] A total of 54 240 residents who met the criteria for study inclusion were invited to participate in our survey, in which 47 325 people (18 976 males and 28 349 females) completed, with an overall response rate of 87.3%. Excluded from the study were 538 subjects due to incomplete demographic information, and 548 subjects were excluded for no availability of fasting blood glucose or post-prandial glucose levels. This left 46 239 subjects to be included in the present study.

The Medical Research Ethics Committee of the China–Japan Friendship Hospital reviewed and approved the present study. Informed consent was obtained from each subject prior to all data collection.

Data collection

Physical examination and questionnaire

A physical examination was performed on all subjects by a qualified doctor according to the established standard methods,[8] including measurements of height, weight, waist circumference, hip circumference, blood pressure, and heart rate. Height was accurate to 0.1 cm and weight was measured to an accuracy of 0.1 kg. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of height (m). A BMI of 25–30 kg/m^2 was defined as overweight, whereas a BMI of ≥30 kg/m^2 was considered obese. Waist circumference was measured as the smallest circumference between the rib margin and iliac crest, and hip circumference was measured as the maximum circumference between the waist and hip. Waist-to-hip ratio (WHR) was calculated by waist circumference divided by hip circumference. After 10–15 min of rest, right upper arm blood pressure was measured twice with an interval of 30 s in a sitting position using a mercury sphygmomanometer. Average blood pressure between the two measurements ≥140/90 mmHg, or a previous diagnosis of hypertension, was defined as hypertensive. Data collection was performed at local health stations or community clinics. During the field survey, a standardized questionnaire was completed by trained doctors and nurses. Data collected from each subject included lifestyle, history of CVD, stroke, diabetes, medication usage, and family history of CHD, stroke, and diabetes (limited to first-degree relatives). Smoking was defined as smoking one or more cigarettes daily for at least 1 year.

Oral glucose tolerance test or a standard meal test

The subjects were asked to not exercise or alter their diet for at least 3 days prior to glucose testing. Overnight fasting blood samples were collected using vacuum tubes containing sodium fluoride, used to determine fasting plasma glucose and lipids. Subjects without a history of diabetes were administered an oral glucose tolerance test (OGTT) of 75 g glucose, whereas subjects with a previous diagnosis of diabetes were administered a standard meal test containing 80 g carbohydrates. Blood samples for glucose determination were collected at 30 and 120 min after either the OGTT or standard meal test. Blood glucose and lipid profile were tested by local laboratories approved by national or provincial quality control systems already in place. The diagnosis of diabetes [impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT)] was based on the 1999 World Health Organization standards. Pre-diabetes was defined as having either IFG or IGT. Hyperglycaemia included a diagnosis of diabetes or pre-diabetes, whereas dyslipidaemia was defined as a serum triglyceride (TG) level of ≥1.7 mmol/L, low-density lipoprotein cholesterol (LDL-C) of ≥3.2 mmol/L, high-density lipoprotein cholesterol (HDL-C) level of <0.9 mmol/L in males, or HDL-C level <1.0 mmol/L in females.

Various non-fatal CVDs were determined according to a patient's self-report. The definition of CHD was a history of hospitalization for myocardial infarction or a surgical history of coronary balloon angioplasty, or coronary stent implantation or coronary artery bypass. The definition of stroke included a history of language or physical dysfunction continuing for more than 24 h and ischaemic or haemorrhagic stroke diagnosed using imaging examination [computed tomography or magnetic resonance imaging]. Cardiovascular disease referred to a history of CHD or stroke, as defined above.

Statistical analysis

All calculations were weighed to represent the total Chinese adult population aged 20 years or older. Weights were calculated based on data from the Chinese population in 2006 using a study sampling scheme, which took into account several features of the survey. These features included oversampling for female and urban residents, non-response, economic development, and other demographic or geographic differences between the sample and the total population.[7] Prevalence estimates were calculated based on the overall population according to age, in which age-standardized prevalence was determined using the population distribution of China in 2006. The Cochran–Armitage trend testing was used to analyse for the trend of prevalence over various age groups. Logistic regression analysis was utilized to examine the association between the family history of diabetes and CVD, and metabolic factors and odds of CVD diseases. Standard errors were calculated using a technique appropriate for the complex survey design. All *P*-values were two-tailed with a significance level of 0.05. Statistical analyses were conducted using the SUDAAN software (version 10; Research Triangle Institute, Research Triangle Park, NC, USA).

Table 1 Coronary heart disease and stroke status among all subjects

Items	CHD	Stroke	No-CVD	*P*-value for CHD vs. no-CVD	*P*-value for stroke vs. no-CVD
Male/female (*n*)	160/153	252/220	18 018/27 458	0.1322	0.0015
DMFH (%)	27.04 (14.37–45.00)	12.54 (8.47–18.16)	15.57 (14.88–16.28)	0.0835	0.2252
MIFH (%)	13.81 (7.94–22.94)	7.24 (4.52–11.39)	6.35 (5.98–6.74)	0.0412	0.6211
StrFH (%)	14.42 (8.43–23.56)	30.61 (22.52–40.10)	11.56 (11.06–12.09)	0.4748	0.0001
Age (years)	60.9 (58.5–63.4)	61.9 (59.4–64.3)	44.6 (44.3–44.9)	0.0000	0.0000
BMI (kg/m^2)	25.18 (24.12–26.25)	25.52 (24.94–26.09)	23.69 (23.63–23.75)	0.0066	0.0000
Waist circumference (cm)	87.5 (85.0–90.0)	88.1 (86.6–89.5)	80.6 (80.4–80.8)	0.0000	0.0000
WHR	0.89 (0.88–0.90)	0.90 (0.89–0.91)	0.86 (0.85–0.86)	0.0000	0.0000
SBP (mmHg)	130.7 (127.1–134.4)	140.6 (137.1–144.1)	121.6 (121.3–122.0)	0.0000	0.0000
DBP (mmHg)	78.9 (76.2–81.7)	83.2 (80.8–85.5)	77.5 (77.3–77.7)	0.3308	0.0000
FPG (mmol/L)	6.1 (5.6–6.6)	5.8 (5.5–6.1)	5.3 (5.2–5.3)	0.0017	0.0001
PG2h (mmol/L)	9.3 (8.5–10.2)	8.6 (7.5–9.6)	6.9 (6.8–6.9)	0.0000	0.0016
T-CHO (mmol/L)	4.83 (3.36–6.38)	4.89 (3.52–6.89)	4.63 (3.25–6.44)	0.0347	0.0001
TG (mmol/L)	1.47 (0.73–3.74)	1.57 (0.66–4.00)	1.23 (0.56–3.74)	0.0400	0.0016
HDL-C (mmol/L)	1.19 (0.75–1.77)	1.29 (0.85–1.88)	1.25 (0.83–1.90)	0.0102	0.7496
LDL-C (mmol/L)	2.83 (1.59–4.84)	3.00 (1.96–4.59)	2.59 (1.46–4.08)	0.0001	0.0000

Mean with 95% CI for age, BMI, waist circumference, WHR, SBP, DBP, FPG, and PG2h. Median with 5–95% for T-CHO, TG, HDL-C, and LDL-C. CHD, coronary heart disease; no-CVD, no cardiovascular diseases; DMFH, family history of diabetes; MIFH, family history of myocardial infarction; StrFH, family history of stroke; BMI, body mass index; WHR, waist-to-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose; PG2h, plasma glucose tested 2 h after oral glucose tolerance test; T-CHO, total cholesterol; TG, triglyceride; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.

Results

General characteristics

Average age, BMI, waist circumference, waist-to-hip ratio, systolic blood pressure (SBP), blood glucose, serum total cholesterol, TG, and LDL-C levels in all subjects who had CHD or a previous stroke were significantly higher than subjects without any history of CVDs ($P < 0.05$). Subjects with CHD had a significantly more prevalent family history of myocardial infarction (13.81 vs. 6.35%, $P < 0.001$) and lower serum HDL-C levels (1.19 vs. 1.25, $P < 0.05$), whereas subjects who had a previous history of a stroke also had a significantly more prevalent family history of stroke (30.61 vs. 11.56%, $P < 0.001$) and higher SBP and diastolic blood pressure (DBP; 140.6 vs. 121.5, $P < 0.001$ for SBP; 83.2 vs. 77.5, $P < 0.001$ for DBP) without a decrease in HDL-C (1.29 vs. 1.25, $P > 0.05$) (*Table 1*) compared with control subjects.

Prevalence of cardiovascular diseases

The prevalence of CHD, stroke, and total CVD diseases was 0.74% (95% CI: 0.57–0.96), 1.07% (95% CI: 0.86–1.33), and 1.78% (95% CI: 1.51–2.11) in males; and 0.51% (95% CI: 0.34–0.79), 0.60% (95% CI: 0.45–0.81), and 1.10% (95% CI: 0.85–1.42) in females, respectively. The prevalence of CHD, stroke, and CVD diseases was higher among subjects with older age in both males and females (all $P < 0.0001$). The prevalence of CHD, stroke, and total CVD diseases in the entire population (including both males and females) was 0.63% (95% CI: 0.49–0.79), 0.83% (95% CI: 0.70–0.99), and 1.44% (95% CI: 1.25–1.66); and the standardized prevalence in the 2006 population was 0.60, 0.80, and 1.37% (*Figure 1*), respectively.

Risk factors for cardiovascular disease

The prevalence of classical CVD risk factors including smoking, being overweight or obese, high blood pressure, dyslipidaemia, and hyperglycaemia was 58.16, 36.67, 30.09, 67.43, and 26.69%, respectively, in males; 3.44, 29.77, 24.79, 63.98, and 23.62%, respectively, in females. At any given age, the proportion of smokers that were males was significantly higher than that of females ($P < 0.0001$). In both males and females, the prevalence of hypertension, dyslipidaemia, pre-diabetes, or diabetes was higher among subjects with older age; however, the proportion of subjects who were overweight or obese was higher among subjects with older age until 60 years of age, when the prevalence began to lower ($P < 0.0001$; *Table 2*).

Cardiovascular risk factor aggregation and the prevalence of cardiovascular diseases

Within the total sample, the prevalence of one subject having 1, 2, 3, or ≥4 of the 5 risk factors, including smoking, being overweight or obese, hypertension, dyslipidaemia, or hyperglycaemia, was 31.17% (95% CI: 30.39–31.96), 27.38% (95% CI: 26.60–28.18), 17.76% (95% CI: 17.11–18.43), and 10.19% (95% CI: 9.73–10.67). The proportion of males who had 2, 3, or ≥4 CVD risk factors was significantly higher than that of females ($P < 0.001$). With the aggregation of risk factors, the prevalence of CHD, stroke, and total CVD diseases was higher (*Table 3*).

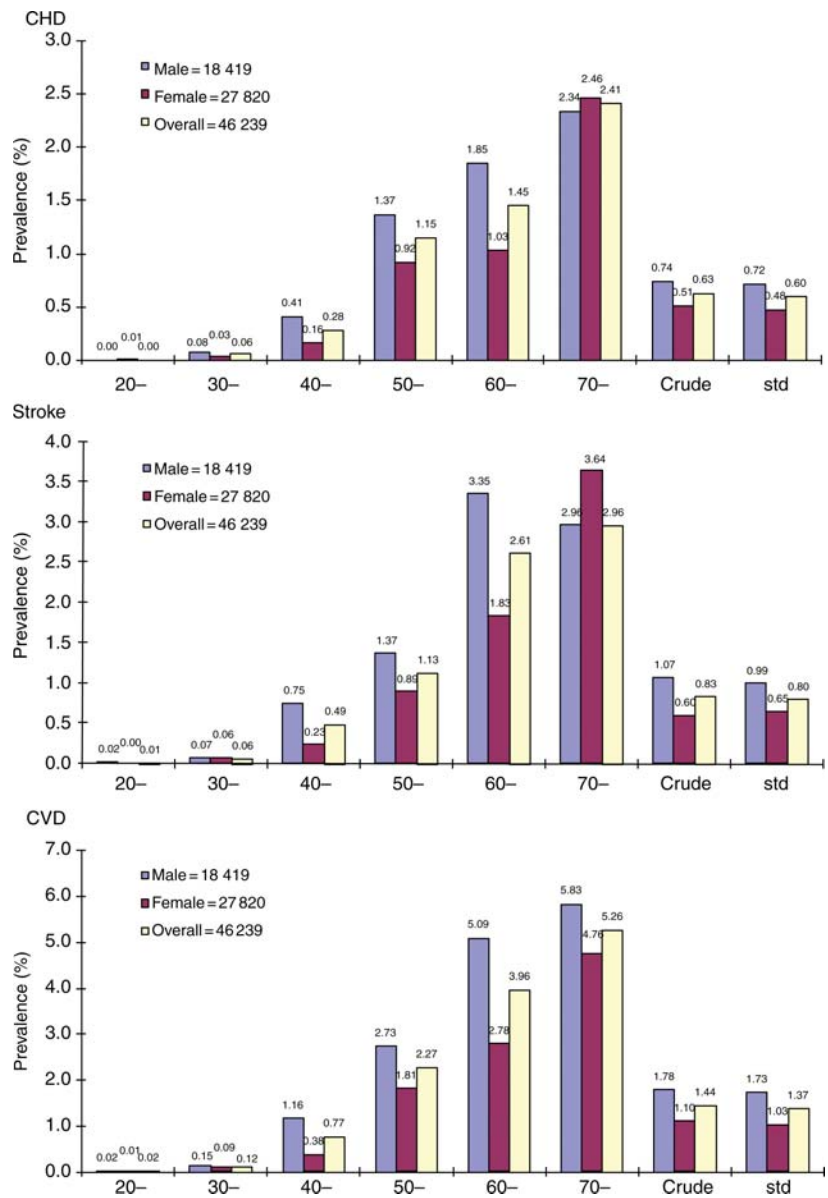

Figure 1 The morbidity of coronary heart disease, stroke, and total cardiovascular diseases in the Chinese population ≥20 years. CHD, coronary heart disease; CVD, cardiovascular diseases; crude, crude prevalence; std, age-standardized prevalence. After the Cochran–Armitage trend test, the prevalence of coronary heart disease, stroke, and cardiovascular disease was higher among subjects with older age in both males and females (all $P < 0.0001$).

Multivariate analysis

Multivariate logistic regression analysis showed that increased age, family history of myocardial infarction, history of diabetes mellitus, smoking, and obesity were all correlated with CHD; increased age, family history of stroke, hypertension, and obesity were correlated with the prevalence of stroke. Total CVDs were related to increased age, family history of stroke, hypertension, and obesity, but with no relationship to diabetes or smoking (*Table 4*). After adjustment for gender and age, the odds ratio values of CVD in subjects having 1, 2, 3, or ≥4 CVD risk factors were 2.36 (95% CI: 1.21–4.59), 4.24 (95% CI: 2.26–7.94), 4.88 (95% CI: 2.56–9.31), and 7.22 (95% CI: 3.85–13.51; *Table 5*), compared with subjects without CVD risk factors.

Discussion

The incidence of CVD remains a debilitating condition throughout the world, with the Chinese population not protected from the harms of this disease. Results of the present study suggest that subjects with a clear history of stroke, myocardial infarction, coronary balloon angioplasty, coronary stent implantation, or coronary bypass surgery were older and more obese, had higher blood

Table 2 **Classic cardiovascular risk factors among various male and female age groups**

Items	20–	30–	40–	50–	60–	70–	Overall
Male							
Cases (*n*)	3096	3989	4363	3746	2318	907	18 419
Smoking	45.48 (41.88–49.12)	56.65 (54.07–59.20)	65.79 (63.53–67.98)	64.77 (62.27–67.19)	57.24 (54.06–60.36)	54.19 (48.34–59.93)	58.16 (56.91–59.40)
BMI ≥25	24.84 (22.16–27.73)	39.15 (36.73–41.63)	40.68 (38.42–42.98)	41.32 (38.81–43.87)	35.62 (32.72–38.64)	33.97 (28.67–39.71)	36.67 (35.52–37.84)
Overweight	19.43 (17.23–21.84)	32.45 (30.16–34.82)	34.50 (32.36–36.70)	35.04 (32.65–37.50)	31.34 (28.58–34.24)	28.86 (23.88–34.40)	30.76 (29.68–31.86)
Obesity	5.45 (3.89–7.59)	6.80 (5.72–8.06)	6.29 (5.34–7.41)	6.44 (5.26–7.86)	4.38 (3.23–5.90)	5.31 (3.14–8.85)	6.02 (5.46–6.64)
Hypertension	9.83 (8.33–11.57)	19.05 (17.32–20.91)	30.00 (27.96–32.12)	39.18 (36.70–41.71)	51.89 (48.66–55.10)	58.47 (52.50–64.20)	30.09 (29.01–31.20)
Dyslipidaemia	63.40 (59.63–67.01)	68.75 (66.36–71.04)	70.67 (68.47–72.78)	69.47 (67.03–71.80)	62.85 (59.77–65.83)	64.26 (58.63–69.52)	67.43 (66.25–68.60)
Hyperglycaemia	10.25 (8.34–12.55)	17.42 (15.67–19.34)	28.86 (26.74–31.08)	33.59 (31.16–36.11)	42.26 (39.14–45.44)	48.22 (42.38–54.11)	26.69 (25.62–27.80)
Pre-diabetes	7.64 (5.93–9.80)	12.22 (10.69–13.93)	17.75 (15.91–19.75)	18.12 (16.18–20.24)	24.13 (21.45–27.03)	26.37 (21.46–31.95)	16.09 (15.18–17.04)
Diabetes	2.61 (1.84–3.68)	5.21 (4.32–6.27)	11.11 (9.82–12.55)	15.47 (13.67–17.46)	18.13 (15.97–20.51)	21.85 (17.35–27.13)	10.61 (9.91–11.35)
Female							
Cases (*n*)	4020	6319	7100	6156	3214	1011	27 820
Smoking	1.53 (1.03–2.27)	1.70 (1.27–2.26)	3.22 (2.66–3.90)	3.81 (3.06–4.75)	6.27 (5.03–7.81)	8.98 (6.30–12.66)	3.44 (3.07–3.85)
BMI ≥25	10.87 (9.32–12.64)	22.95 (21.24–24.75)	36.41 (34.69–38.17)	41.46 (39.57–43.75)	41.57 (38.77–44.43)	32.71 (26.84–39.18)	29.77 (28.81–30.74)
Overweight	9.04 (7.58–10.75)	19.71 (18.08–21.45)	30.77 (29.13–32.46)	34.80 (32.82–36.84	34.60 (31.91–37.39)	25.51 (20.51–31.25)	24.90 (24.00–25.81)
Obesity	1.84 (1.39–2.43)	3.26 (2.64–4.03)	5.75 (4.98–6.63)	6.97 (5.99–8.10)	7.06 (5.91–8.42)	7.22 (4.60–11.16)	4.92 (4.51–5.38)
Hypertension	4.05 (2.88–5.67	7.63 (6.74–8.62)	22.55 (21.10–24.08)	39.31 (37.28–41.39)	52.02 (49.09–54.94)	61.17 (53.75–68.12)	24.79 (23.71–25.90)
Dyslipidaemia	58.70 (55.62–61.71)	59.56 (57.54–61.55)	63.95 (62.28–65.59)	69.06 (67.17–70.89)	69.43 (66.73–72.00)	70.81 (64.57–76.35)	63.98 (62.94–65.01)
Hyperglycaemia	6.96 (5.91–8.17)	12.19 (11.05–13.43)	23.32 (21.85–24.86)	34.15 (32.17–36.19)	42.48 (39.67–45.33)	48.15 (40.58–55.80)	23.62 (22.62–24.66)
Pre-diabetes	5.72 (4.77–6.84)	9.18 (8.23–10.23)	16.01 (14.75–17.36)	21.07 (19.36–22.88)	22.19 (19.97–24.59)	26.18 (19.41–34.31)	14.90 (14.03–15.81)
Diabetes	1.24 (0.86–1.78)	3.01 (2.39–3.78)	7.30 (6.44–8.27)	13.09 (11.79–14.50)	20.28 (18.16–22.58)	21.97 (16.93–28.00)	8.73 (8.11–9.38)

Table 3 Relationship between clustered cardiovascular risk factors and the prevalence of cardiovascular diseases

Items	0 risk factor	1 risk factor	2 risk factors	3 risk factors	≥4 risk factors	*P*-value for trend
All sample						
Male	7.49 (6.78–8.26)	22.41 (21.32–23.53)	32.35 (31.17–33.55)	22.77 (21.77–23.81)	14.99 (14.18–15.83)	0.0000*
Female	19.37 (18.50–20.27)	39.74 (38.64–40.85)	22.53 (21.49–23.60)	12.86 (12.05–13.71)	5.50 (5.06–5.98)	
Overall	13.5 (12.93–14.09)	31.17 (30.39–31.96)	27.38 (26.60–28.18)	17.76 (17.11–18.43)	10.19 (9.73–10.67)	—
CHD						
Male	0.11 (0.03–0.44)	0.51 (0.23–1.13)	0.61 (0.34–1.11)	0.92 (0.61–1.37)	1.40 (0.89–2.19)	0.0000
Female	0.09 (0.04–0.18)	0.17 (0.09–0.33)	0.60 (0.34–1.05)	1.68 (0.69–4.01)	1.44 (0.73–2.81)	0.0004
Overall	0.09 (0.05–0.18)	0.29 (0.17–0.51)	0.61 (0.40–0.92)	1.20 (0.73–1.96)	1.41 (0.97–2.05)	0.0000
Stroke						
Male	0.09 (0.02–0.34)	0.51 (0.29–0.90)	1.13 (0.72–1.76)	1.21 (0.83–1.76)	2.05 (1.46–2.88)	0.0000
Female	0.09 (0.03–0.28)	0.15 (0.07–0.35)	0.88 (0.45–1.73)	1.08 (0.75–1.56)	3.36 (2.06–5.42)	0.0000
Overall	0.09 (0.04–0.22)	0.28 (0.18–0.45)	1.02 (0.70–1.49)	1.16 (0.88–1.54)	2.41 (1.82–3.18)	0.0000
CVD						
Male	0.20 (0.08–0.53)	1.03 (0.63–1.66)	1.71 (1.19–2.45)	2.09 (1.58–2.75)	3.40 (2.59–4.47)	0.0000
Female	0.18 (0.09–0.35)	0.32 (0.19–0.55)	1.46 (0.92–2.33)	2.71 (1.54–4.72)	4.69 (3.13–6.95)	0.0000
Overall	0.18 (0.11–0.32)	0.57 (0.40–0.82)	1.61 (1.21–2.14)	2.32 (1.73–3.09)	3.75 (2.99–4.70)	0.0000

Five classic CVD risk factors which can be controlled: smoking, being overweight or obese, hypertension, dyslipidaemia, or hyperglycaemia.
**P*-value for males vs. females.

Table 4 Multiple logistic regression analyses of coronary heart disease, stroke, and cardiovascular disease

Items	CHD		Stroke		CVD	
	Odd ratio (95% CI)	*P*-value	Odd ratio (95% CI)	*P*-value	Odd ratio (95% CI)	*P*-value
Males	1.01 (0.54, 1.88)	0.9694	1.57 (0.94, 2.61)	0.0826	1.31 (0.87, 1.98)	0.2002
Age (10 years)	2.10 (1.68, 2.62)	0.0000*	2.19 (1.78, 2.69)	0.0000*	2.17 (1.86, 2.53)	0.0000*
Family history of diabetes	2.23 (0.89, 5.63)	0.0885	0.74 (0.45, 1.24)	0.2585	1.29 (0.68, 2.43)	0.4336
Family history of AMI	2.40 (1.15, 5.01)	0.0196*	0.87 (0.44, 1.74)	0.6908*	1.49 (0.86, 2.59)	0.1547
Family history of stroke	0.75 (0.38, 1.50)	0.4202	2.74 (1.76, 4.26)	0.0000*	1.75 (1.18, 2.60)	0.0051*
Diabetes vs. NGT	2.44 (1.31, 4.53)	0.0146*	0.97 (0.59, 1.61)	0.6154	1.43 (0.92, 2.23)	0.0800
Smoking	1.76 (1.03, 3.01)	0.0395*	1.17 (0.74, 1.84)	0.5093	1.41 (0.98, 2.02)	0.0616
SBP(10 mmHg increment)	0.95 (0.87, 1.03)	0.2225	1.15 (1.04, 1.27)	0.0047*	1.08 (1.00, 1.16)	0.0433*
Waist Circumference(5 cm increment)	1.18 (1.02, 1.36)	0.0234*	1.21 (1.10, 1.32)	0.0001*	1.20 (1.10, 1.31)	0.0000*
LDL-C	1.04 (0.53, 2.00)	0.9180	0.99 (0.64, 1.53)	0.9589	1.03 (0.70, 1.51)	0.8829
HDL-C	1.13 (0.54, 2.39)	0.7463	0.94 (0.53, 1.65)	0.8211	1.05 (0.65, 1.69)	0.8447
TG(50 mg/dL increment)	1.04 (0.90, 1.21)	0.5777	0.98 (0.86, 1.12)	0.7705	1.01 (0.91, 1.11)	0.8892

NGT, normal glucose tolerance; SBP, systolic blood pressure; T-CHO, total cholesterol; TG, triglyceride; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.
*$P < 0.05$.

pressure, total cholesterol, LDL-C, and TG; and had lower HDL-C levels than subjects without histories of CVDs. Familial history plays an important role in the progression of CVD, with descendants with a family history of myocardial infarction prone to suffer from CHD, and descendants with a family history of stroke prone to suffer from stroke. Following adjustment for age, smoking, obesity, blood pressure, blood sugar, blood lipids, and other factors, the above results remain intact.

The MONICA plan (Sino-MONICA project) showed that the annual morbidity and mortality of Chinese males and females with CHD is well below the values present throughout the rest of the world. However, annual morbidity and mortality of stroke

Table 5 Odds ratio of total cardiovascular disease according to risk factors

Items	Odd ratio (95% CI)	*P*-value
Males	1.39 (1.01, 1.93)	0.0459
Age (10 years)	2.13 (1.91, 2.38)	<0.0001
1 risk factor	2.36 (1.21, 4.59)	0.0116
2 risk factors	4.24 (2.26,7.94)	<0.0001
3 risk factors	4.88 (2.56, 9.31)	<0.0001
≥4 risk factors	7.22 (3.85,13.51)	<0.0001

Five classic CVD risk factors which can be controlled, including smoking, overweight or obese, hypertension, dyslipidaemia, or hyperglycaemia.

were higher in China than the rest of the world, with a CVD type similar to that seen in Japan, Korea, and other Asian countries.[9] Due to the diversity of clinical types and complexities of diagnosis for CHD and stroke, which is different from hypertension, diabetes, and other epidemics, it is difficult to perform a large-scale survey on the prevalence of CVD in Chinese patients. From the China Diabetes and Metabolic Syndrome Prevalence Study, we designed the questionnaire used in this study to obtain more accurate and objective data on non-fatal CVDs. Our questionnaire included whether the subject had ever had an established cardiovascular and cerebrovascular diseases, such as whether the patient had been diagnosed as suffering from a myocardial infarction, had stent implantation, coronary balloon angioplasty, or coronary artery bypass surgery in the past, or whether the patient had been diagnosed with stroke, but angina, arrhythmia, transient ischaemic attack, or other disease conditions not included in the present study. Our results show that the defined total of CVD prevalence was 1.44%, including 0.83% of stroke and 0.63% of CHD in Chinese adults over 20 years of age, which was significantly higher in males than females. These results also indicate that stroke is still the most prevalent form of CVD and the major cause of death and disability.[2,9,10]

During the past 50 years, CVD-related morbidity and mortality in developed countries have decreased significantly,[11–14] whereas many low- to middle-income developing countries have entered the so-called 'epidemiological transition'. This transition defines alterations in disease patterns from communicable diseases to nutrition-related non-communicable diseases, including type 2 diabetes, CHD, stroke, hypertension, and certain tumour-related disorders.[15] In countries where this transition is occurring, 80% of CVD death and 87% of CVD-related disability have occurred.[16] According to a recent report, death from non-communicable diseases in developing countries will account for more than 70% of all causes in 2020.[2]

China remains a developing country with the world's fastest growing economy. With the acceleration in urbanization, industrialization, and the westernized lifestyle, the prevalence of overweight and obesity, hypertension, lipid disorders, and diabetes in Chinese has begun to dramatically increase. Our results showed that the prevalence of subjects overweight or obese was 30.76 and 6.02% in males, and 24.90 and 4.92% in females, respectively; this prevalence was only 18.9 and 2.9% in the 18-years-and-older population in the 2002 China Nutrition Survey.[17] Our data show that the prevalence of hypertension in this population was 30.09 and 24.79% in males and females, respectively, similar to the results of a study reported in 2002.[10,18] However, the 2002 study included subjects over the age of 35 years. Moreover, the prevalence of pre-diabetes and diabetes increased 300% according to our data compared with that seen in a 1994 national survey.[7,8] The proportion of patients who smoked or who had another CVD risk factor was 58.16% in males and only 3.44% in females; furthermore, the proportion of male subjects who smoked between the ages of 20 and 30 reached 45.48%. Therefore, the ability to control the use of tobacco is a critical task for departments of health management and other relevant governmental departments. Smoking, being overweight or obese, hypertensive, dyslipidaemic, and hyperglycaemic are the traditional CVD risk factors for CVD; however, these are all controllable by diet and exercise.

Our study has potential limitations, some of which have been mentioned in previous studies by our group.[6] The data presented in the present study were obtained in the 2007–08 China National Diabetes and Metabolic Disorders Study, which was not a typical CVD survey. In this study, we relied on self-reporting to identify CVD; therefore, a small proportion of individuals with undiagnosed CVDmay have been misclassified. Furthermore, for self-reported data, there was no validation done on a subsample of the results to provide enough information. The data in our study also did not include results for angina or arrhythmias, so the results of CVD-related morbidity are not all-inclusive. Also, this study was a representative of non-fatal CVD events only since fatal events could not be assessed in a cross-sectional study. Finally, there are many preventable and unpreventable factors related to CVD progression, although we only investigated defined major risk factors for CVD. Further studies are warranted that include broader risk factors known to be related to CVD progression. However, we believe that the present study represents valuable information on the prevalence of CVD-related risk factors that are potentially alterable, and will provide the knowledge required for policy-makers and clinicians involved in treatment plans.

With the rapid changes in lifestyle, morbidity related to various cardiovascular risk factors has increased rapidly in China; with multiple risk factors clustered in the same individual, the progression of CVD remains grim. Based on the results of our present study, departments of public health management and clinicians should provide adequate risk assessment strategies and further preventative strategies to attenuate the rapid rise in cardiovascular morbidity.

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